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Keywords

labour, home, industrial, linking, plant:, perimeter, beyond, repair, maintenance

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Dominant political economic accounts of manufacturing labour draw on an intellectual heritage that has tended to over-emphasise production culture within the industrial workplace, at the expense of other work cultures such as maintenance and repair. When the latter are foregrounded, new links emerge between work undertaken within the paid workplace, and that undertaken in the home and community. Work that occurs outside the bounds of an industrial site is co-constituted by materials and skills engendered within, raising timely political and geographical questions around the visibility and mobility of these prosaic restorative cultures. Empirically the article brings together two perspectives to illustrate: first, an auto-ethnographic account of the author's experience as an apprentice industrial electrician in an Australian steel mill in the early 1990s. Emboldened by the work of feminist geographers, I reflect on the spaces occupied by maintenance and repair workers, with an interest in how they cultivate socio-material cultures that transpire across the bounds of paid and unpaid work. Second, qualitative interviews conducted two decades later, in the homes of retired maintenance trades workers from the same plant. Throughout long careers, these workers have embraced – in both attitude and praxis – the labour of maintenance and repair both at work and at home. Their case demonstrates modes of living thoughtfully with materials that have the potential to reanimate the industrial city as a site of geographical enquiry. The paper urges labour researchers to return to the industrial city and to look beyond the production paradigm, to explore more deeply the heterogeneity of shopfloor cultures, in order to account for the full value, and thus the potential, of industrial life.

Prologue

The tips of my fingers are tender and raw, and I can't stop worrying them. I don't belong here. I've been filing and cutting and drilling and bending bits of steel for weeks. I don't know what I'm doing, but I know from the very first week that I've made a huge mistake. Everyone around me gets it straight away, but my stomach curdles with every call to a different machine or power tool for instruction. The other new apprentices jump on the drill press or the acetylene torch straight after the instructor has finished the demonstration, asking questions while he is still in the moment. The next day I miserably try to remember the answers to the questions they asked. For me there's always a lag, while I catch up on the tasks that preceded this new step. The instructors seem intent on leaving me to my own devices, and I can only hope it's because they don't notice how little I know.

But as the weeks progress I'm surprised by how I begin to adapt to this new material and social world. I fashion a drill gauge, then some test lamps, and a soldering iron with a hand-filed copper tip that I rub optimistically in a shallow pool of Prussian Blue, looking for high spots. At the end of the fifth month, I've made a battery charger and variable power supply from scratch: winding and laminating copper coils, soldering circuit boards, braiding bundles of cables and folding and punching the metal case. Slowly the work shifts from these personal projects to the kind of work we'll do out on the plant. I learn to overhaul the big horseshoe brakes that bring giant gantry cranes to a stop. My skills are growing, and now include commercial wiring, useful outside of the workplace as well as within. I fit insipid fluorescent lights and waterproofed power outlets into lunchrooms and changerooms. I learn to mimic better: going first and getting it wrong is better than being last and too scared to start.

Introduction

This article begins at a place and time I vowed upon leaving never to re-visit: the apprentice-training workshop of a large steel plant in Australia, in the early 1990s. I pursued this job with the predictably defiant singularity of an 18-year old ready to leave school, and intent on doing anything other than what was expected. Over the first four years of my adult working life, I moved from the training centre through various maintenance workshops of the steel plant, as an apprentice industrial electrician. This chapter of my life is removed from the present by nearly twenty years. I left the steelworks in 1997, determined to put as much distance between myself and the spaces and cultures of industrial work as I could. Yet also completely oblivious as to how those years would linger in my conscious, and how I would circle back to them in time.

Not long before I mis-stepped into an industrial life, Linda McDowell (1992: 409) called for researchers in the social sciences to ‘recognise and take account of our own position, as well as that of our research participants, and *write this into our research practice*’. In 2012 I returned to the city as a geographer interested in material labour, with an eye trained on the subsidiary cultures that sustain ‘the stuttering business of making steel’ (Swanton 2013: 283). The intention was to document the experiences of the maintenance workers with whom I had once shared a workplace, and my interest was partisan: I sought to look obliquely across advancing narratives of industrial decline, to illuminate the everyday cultures of making and material skill that underwrite production. The embodied work that is all but invisible when industrial processes and manufacturing sites are viewed – as they predominantly are in geography - through the lenses of capital or organised labour (Swanton 2013; Tonkin 2000).

Acutely aware that the project would meet with resistance or indifference from the company, and mindful of my working knowledge of the spaces and cultures workers would discuss, the decision to conduct interviews with steelworkers in their homes was straightforward enough. Yet as I moved around the sheds and garages of the steelworkers during interviews, a different perspective on the project emerged. I was struck by how much of the workplace I once knew intimately – its material cultures, work practices and routines – had spilled out into the homes of workers. A focus on the spaces and cultures of the workplace was displaced by the emergent theme of the home as a site to perform skilled labour (c.f. Cox 2014, 2015). Prolific and sophisticated collections of industrial tools, machinery and materials, together with narratives of how they were deployed throughout the home and more widely across the community, worked to confound perceptions of the tightly held spatial and temporal boundaries of industrial work. This work occurs in the domestic ‘sphere’, yet it is co-constituted by materials, skills and cultures originating within the bounds of the workplace, affording a new perspective on links between industrial labour and the home. While through the lenses of capital or collective labour these activities become acts of resistance or struggle within the prevailing system (c.f. Adams Stein 2015; Anteby 2008), when viewed from the household, they should be taken seriously and viewed as work. Though unpaid and often largely unsanctioned, such work has contributed substantially over time to the broader city where workers go about lives beyond the enterprise.

Maintenance and repair: an epistemological view from the industrial city

Situated along a narrow strip of coast 70 kilometres south of Sydney, the southern skyline of the city of Wollongong is dominated by emblematic industrial icons: gas stacks and conveyor belts (Eklund 2002; Schultz 1985). Bounded to the west by an escarpment that still produces coal, at

its geographical heart lies the Port Kembla steelworks, a securitised 760 hectare ‘black hole’ in the city fabric, where suburban notions of scale, form, texture and movement are momentarily suspended. Swanton (2013: 283) captures the sensory assault of ‘the overwhelming array of technologies, materials and cultures that must hold together for a steel plant to function’.

Reminiscent of the Victorian cities of the industrial revolution, the Port Kembla plant is today an intricate patchwork of add-ons, modifications, de-commissioned machinery, and adapted buildings –layers of a process that has constantly adapted to shifting commodity, technological and labour demands throughout the twentieth century.

In this landscape where so many temporalities coalesce, maintenance and repair is fundamental smoothing work, restoring order amidst interminable slippage and misalignment (Jackson 2014). Graham and Thrift (2007) have argued that little is known about the labour that goes into keeping the systems that sustain society operational. This is certainly true in the case of industrial production. As yields rise and fall, such work is unremitting. Yet just as other ‘non-productive’ work is absent from national productivity accounts (Domosh and Seager 2001; McDowell 2015), so too is maintenance and repair work imperceptible within yield figures, rendering it invisible in the eyes of executive and shareholders alike. Maintenance and repair work is also curiously absent from scholarly accounts of industrial production, including many of those built on the empirical foundation of steelmaking (though some shopfloor accounts touch on it; see for example Burawoy 1989; Swanton 2013). The effect is one of deep imbalance in rendering the different labour cultures of the industrial site, where the modes of work that underwrite production have been de-emphasised. Repair and maintenance workers have become the ‘missing “Others”’ (McDowell 2015: 3) across an analytical and corporate industrial landscape

that continues to reify production. Moreover, their absence has persisted through various epochal shifts in the economic and social organisation and analysis of industrial life.

Yet maintenance and repair offer a critical foundation for re-valuing the prosaic skills and dispositions that industrial life has historically engendered. Graham and Thrift (2007: 5) have proposed that working within an environment where breakdown and failure are normalised produces a disposition towards 'learning, adaptation and improvisation'. This outlook is evident amongst the cohort of workers interviewed for this project, who are embedded in the quotidian rhythms and violent materiality of steelmaking through two overlapping and intersecting temporal cycles: first maintenance, an ongoing process of adjustment that inherently looks to the future (what needs to be done so that disruption can be minimised); and second repair, which traverses the ground between past and present in its concern with restoring functionality to a prior state of operation (see also Dant 2010; Edensor 2011). In contrast with more prevalent depictions of industrial labour as repetitive and alienating, both of these work modes are profoundly contingent (Denis and Pontille 2015; Graham and Thrift 2007; Jackson 2014). Some workers become skilful at responding rapidly and creatively across scales and technologies, on a production process that seldom ceases completely without intent, yet rarely proceeds to full capacity without issue (de Laet and Mol 2000). Others meanwhile have their own deep specialisms: specific physical tasks, particular parts of the process, or a certain type or brand of equipment, which confound simplistic (and productionist) notions of industrial labour as an interchangeable unit of value exchange (Castree et al 2004).

But what is particularly interesting about the repair and maintenance cultures at Port Kembla is how they have transcended the bounds of paid work, where workers extend the same methods, practices, skills, ethics and values that constitute their paid work to the other spaces they occupy, across the home and the community. Spelman (2002) has argued that repair (and I propose maintenance shares the same qualities) has an infinitely broad remit: it manifests in almost every aspect of life, from roads to teacups to relationships. Yet its labour and material processes often remain invisible, despite being fundamental to how everyday life proceeds (Graham and Thrift 2007). The empirics that follow explore these themes by drawing particular dispositions and ways of working with materials out of the industrial setting and into a broader whole-of-life context. Repair and maintenance are conceived of as ethico-political labours that invoke ways of living more thoughtfully within a framework of already-existing materials, technologies and social relations (Puig de la Bellacasa 2011). The implication is that while old industrial regions are increasingly characterised by tropes of malaise and redundancy, their workforces might also be regarded as an undervalued reservoir of profound material knowledges, usefully oriented toward fragility and uncertainty, and deeply accepting of the vitality of matter (Bennett 2010; Carr and Gibson 2016; Denis and Pontille 2015). Conceptualising repair and maintenance in terms of material capacity and resourcefulness (Mackinnon and Driscoll Derickson 2012) renders its wholesale subsumption within the discourses of production materially, spatially and politically fraught. Rather, repair and maintenance encircle a host of radically undervalued activities that are fundamental to how capitalist production – but also life more broadly - proceeds.

An exploration of how industrial repair and maintenance skills and cultures cut across the bounds between the paid workplace and the home raises questions around how different kinds of restorative work come to be understood as gendered. Repair and maintenance work may be configured as a profession or occupation, as a skill, talent or disposition, as a responsibility or chore, or even as an enjoyable pastime, depending on where requisite activities take place, who does them, and subsequently, how they are valued (Hall and Jayne 2016). As feminist scholars have consistently argued, home is a key site where gendered subjectivities are constituted, particularly around work and labour (Cox 2013, 2014, 2015; McDowell 2002). For working-class men, the home has been constructed as a site of respite from the demands of physical work (Mackenzie and Rose 1983). But it is also much more than this (Gorman-Murray 2008). A re-working of the home to include men's skilled physical work highlights how particular kinds of work are not inherently gendered, but rather come to be so through the structures and spaces in which they proceed.

In the following sections, I first draw on feminist perspectives on labour, to explore how value is ascribed to work that remains outside normative temporal and economic definitions of productive activity. This work is important because it provides a rich framework from which to approach the re-valuation of repair and maintenance work across the quotidian rhythms of participants' lives – both within and outside the paid workplace. I then outline the methodological context, attending particularly to the use of auto-memory methods, before turning to the main empirical task of working through how material work cultures cut across the boundaries of the paid workplace and the home. I illustrate how shopfloor routines of repair and maintenance do not get packed away with the tools at the end of the 'working' day (or life), but

rather accompany workers out into the home and community. The case raises timely political and geographical questions around the visibility and mobility of these prosaic restorative cultures, amidst the more ingrained narratives of alienating production work that still populate dominant approaches to industrial labour (Dudley 1994; Graham and Thrift 2007). Such scripts, I would argue, continue to draw from conceptual frameworks that have failed to account for the heterogeneity of shopfloor cultures, and in turn have failed to recognise the full value, and thus the potential, of industrial life.

‘Life’s work’: Locating labour outside of the production-reproduction binary

Feminist economic and labour geographers have made substantial progress on unpacking the concept of work, and troubling the ideological, material and historical construction of its boundaries (England and Lawson 2004; Hanson and Pratt 1988; 1995; McDowell 1999; 2006; 2015; McDowell and Massey 1984). Critiques of the gendered construction of production and reproduction have led to the growing acceptance that work takes many forms across the physical bounds of the public-workplace and the private-domestic, across temporal distinctions between ‘company time’ and leisure time, and in economic modes both paid and unpaid (Blunt 2003; Cameron and Gibson-Graham 2003; Hanson and Pratt 1988; 1995; Mackenzie and Rose 1983; McDowell 1999; Pocock 2003). The blurring of such boundaries has led Mitchell, Marston and Katz (2003) to propose the ubiquitous ‘life’s work’, as a way of working through the entrenched production-reproduction binary, and accounting for the full range of contexts in which value is produced across the gamut of life.

‘Life’s work’ is a useful catalyst for engaging this case study with the core feminist proposition that work is not confined to a ‘sphere’ or the bounds of the paid workplace, but manifests in the many other places workers occupy, including the home and the neighbourhood (Mackenzie and Rose 1983). As Mitchell, Marston and Katz point out (2003: 417) ‘life’s workers’ are most clearly depicted in the contemporary knowledge economy (see also Gregg 2011). They are the ‘new, flexible subjects of late capitalism’, who, with the aid of technology, have seen the temporal bounds of their paid workday increasingly obscured, in a case that vividly illustrates the limits of examining social relations only at the point of production. Yet extending the same analytical proposition to the study of industrial repair and maintenance workers brings a different perspective - one which locates ‘life’s work’ outside of the more insidious regimes of flexible accumulation that structure contemporary work patterns (Mitchell, Marston and Katz 2003: 429). Maintenance and repair as ‘life’s work’ becomes a conduit through which the domestic and the industrial are linked, extending previously bounded cultures of work deep into the homes and lives of those interviewed for this research. Participants derive satisfaction (and even enjoyment) from the challenges of their labour, such that they actively seek to deploy the same skills, methods and ethics widely and frequently in their ‘own’ time. In doing so, they exemplify the argument many feminist scholars have long made: that lives are not lived neatly within the confines of discursive categories, but in the intersecting spaces and temporal modes of home, work, the community, and other institutions (England and Lawson 2004; Hanson and Pratt 1988).

While this point has been broadly made both empirically and conceptually (most frequently in relation to women’s work), its application in the context of industrial work brings two key

insights. First, industrial workers are rendered not only as an input within the framework of capitalist social relations, but rather as workers who consciously mobilise the skills (and labouring identities) such relations have fostered across the other places they inhabit (Byrne 2002; Lovelock 1999; McDowell 2015; Strangleman and Rhodes 2014). A second, related point is that capitalist social relations do not define every aspect of industrial labour, but rather there are many other relations – material and economic included - that emerge from the heterogeneous cultures of the industrial workplace over time, that have been somewhat obscured by the emphasis on the political economy of industrial life.

Feminist perspectives on work and value

It has been more than 20 years since Gibson-Graham (1993: 20) first implored researchers to ‘look within and behind the market’, at the many kinds of non-market transactions that constitute everyday life. Such transactions they argued, are substantially undervalued for their potential to fragment the impressions of unity, singularity and totality that are tied to capitalist hegemony. This feminist critique of the political economic analytical framework has provided the foundation for a legacy of work that resists the relegation of ‘non-market’ activities to a secondary sphere. Rather, Gibson-Graham advocate for researchers to focus their transformative energies on the many ways in which surplus labour is (and can be) appropriated, outside of a pervasive capital-centred discourse, that has stalled on ‘two great classes locked in millennial struggle’ (Gibson-Graham 1993: 22).

The work that participants in this study do outside of the paid workplace brings the continuity of life's work, and the communal appropriation of surplus labour into conversation, in an unlikely setting embedded deep within the trajectory of modernist industrial capital accumulation. While on one level these work activities resonate with the now extensive literature within geography and cognate disciplines on tinkering, DIY, salvage, repair and restoration (see for example Cox 2013, 2015; Gregson et al 2010; Gregson, Metcalfe and Crewe 2009; Hall and Jayne 2016; Pickering 2005), there are also differences to account for: the skills being deployed by workers at home often require a high level of training, alongside professional experience. That is, they can't be performed by enthusiast laypersons or DIY operators - electrical work is one prominent example. Moreover, many of the skills being deployed have significant market value, even – or perhaps especially - within the domestic context.

As Gibson-Graham (1993; 2013) and collaborators have long pointed out, in order to take seriously the untold potential of diverse economies, we must be careful of how we characterise these activities in relation to the hegemony of *the market*. Accordingly, I resist the characterisation of such work as tinkering, but rather frame it as a mode of skilled work that is most often unpaid, yet has tangible material, social and economic effects on the city. Moreover, the work is deeply embedded within existing networks of reciprocity that constitute everyday life both within and outside the enterprise. Acknowledging that particular modes of work resonate across the bounds of paid and unpaid activity as well as industrial and domestic space creates an opportunity to re-evaluate the skills and work dispositions that industrial workers embody, as well as to re-visit normative (and longstanding) assumptions about the dualism of work and leisure in the industrial city. Moreover, it opens up a political project that positions these workers

further from discourses of the inevitable demise of manufacturing, and rather at the centre of more resourceful ways of living (incorporating socio-material economies of thrift, sharing and generosity) that reanimate the maligned industrial city as a site of geographical enquiry (Carr and Gibson 2016; Cumbers, Helms and Swanson 2010).

Working alongside: orientations towards the field

The empirics that follow draw from extended qualitative interviews with 18 participants who had performed skilled maintenance work across electrical, mechanical and fabrication trades at the Port Kembla steelworks for between 22 and 36 years. Interviews were centred on a garage or shed space within the home environment, chosen for its proximity to projects ‘in progress’, and initially selected as an intermediary space between the industrial ephemera of the work environment and the privacy of the home. We looked at goods and materials that had been collected within the space, but also explored the broader home to examine sites or things that had been produced or mended by the participant, using skills and often equipment acquired in the workplace. Often participants also produced photos of projects they had previously completed. The interviews were unstructured, rather using the items at hand as cues for long conversations centred on how participants used, valued and interacted with the physical and social world.

But my own situated experience also brought with it other frameworks for analysis – in particular participant observation and auto-memory work. In more than half the interviews, the participant and I spent time disassembling things that had been made, to talk about how they had been made or repaired, and where different parts had come from. Often we cleaned or made

minor repairs to items before reassembling them. On several occasions, participants started to work with a project as we were talking about it, and I stayed and worked with them until it was complete. In most interviews, we ruminated together on prospects for a particular project, discarded material or salvaged item. During these interviews then, the role of the researcher morphed fluidly from ethnographer to observing participant to actively working alongside participants and ‘talking while working’ (McMorran 2012: 491).

On auto-memory work

The primary objective of the traces of auto-memory work in this paper is to invite a consideration of the heterogeneity of shopfloor culture within the bounds of the steelworks that is not easily visible through ‘traditional’ industrial fieldwork (in itself increasingly rare due to concerns of safety and security – see Swanton 2013). The recollections open up the social spaces that act as refuges for workers amidst the ebb and flow of repair and maintenance work, and which over time become integral to constituting the bodies and minds that in turn keep the production process operating. Using the opening account as an illustrative example, the (now defunct) trades training centre was not, as its materiality and spatiality might have suggested, a space of industrial production. Seven months passed before apprentices worked on anything that would go back out onto the plant. It was staffed by ‘instructors’, not supervisors or foremen. The projects were largely for personal use, varying little in the 22-year gap between when the oldest participant entered the trades training workshop in 1972 and my own experience there. The training centre was located within the bounds of production, but its main purpose was reproductive. Beyond the accumulation of technical knowledge, it was about learning *how things are done*, reflecting Marchand’s (2008) work on apprenticeship as grounded in both personal and

professional development (see also Suchman 1987). New, unskilled workers were delivered (most often straight from the schoolyard) into an intermediary space where they were conditioned over the course of a year to the rhythms, socialities and hierarchies of maintenance and repair work in the industrial workplace. It was the first step in a well-rehearsed schema of producing the 'right' kinds of minds and bodies that go on to anticipate disruption, respond resourcefully to breakdown, and keep the plant running at all costs.

These socialising spaces are central to producing the different kinds of labour that underwrite production, yet they rarely figure in accounts of industrial life. Consequently, their decline (as is the case now with the apprentice training centre at Port Kembla) goes unacknowledged, and their cultures undocumented. The outcome is a depiction of shopfloor culture that is monolithically production-oriented, often disembodied in its representation and *only* collective in its politic. The industrial workplace remains curiously unmarked by the kind of texture that might be expected in a place where multiple subjectivities and relations - nationality, age, gender and ability included - unfold every day alongside the more discursively dominant relations of class (Coe 2012; England and Lawson 2004; Gibson-Graham 1993; Tonkin 2000). The encounters within are thus intended to direct attention to the multiplicity and diversity of the shopfloor cultures that underwrite production. They open up an opportunity to render the difference between industrial subjects (Mitchell, Marston and Katz 2003), and to consider how those differences might produce alternate ontological and epistemological perspectives, that manifest both in daily work and over the long term, within the formal workplace and outside of it.

Linking industrial labour and the home

The mood is jovial as we return from the morning's work. I'm a third year apprentice in the Basic Oxygen Steelmaking (BOS) plant, where 400 tonne gantry cranes shift giant ladles of metal super-heated to 1600 degrees Celsius. It's the most volatile area of the works, and I'm rarely physically comfortable. I line up at the basin to wash. Between the tiles, the grout is hidden by thick black channels of grime that come with a hundred workers sluicing water and dirt from their hands many times a day. The dirt is all the same; a sparkling grey dust so sticky and fine it doesn't distinguish between skin or clothes. In the fitters' section, an impromptu game of football starts with a ball made of foam packaging taped together. It flies over the lockers and hits a cup of tea, the tin cup bouncing and tea seeping into the concrete floor beside me. Our leading hand Paul looks at me and shrugs, while John shouts a string of expletives over the lockers in Macedonian. The player who collects the ball returns the insults. He and John laugh.

Upstairs, the long tables of the crib room have a deeply ingrained structure. In the far left there's a table of electricians, all engrossed in newspapers. They're unfazed by the larrikin boilermakers at the next table, whose loud nasal voices and muscle car brinkmanship get louder as the hour progresses. Under the window are the new riggers that no one has yet spoken to. Eight Pacific Islanders, the only ones in the room on contract, their hulking masculinity only slightly less intimidating than the boar's head one of them has roasted in the pie oven. Through the centre is a loose Mediterranean hierarchy of old and garrulous trades assistants. Many are post-war migrants who have worked here since the week they arrived. Their blues are washed pale and their gait is slow. I often wonder how they make it up onto the cranes. But still they clamber over each other to get the overtime shifts. It looks jovial as they sit down to hot pots and

bread, but the Balkan conflicts have recently re-ordered everything. The Serbians and Croatians have moved to opposite corners and hurl insults at each other. Lots of spitting too, the sticky, visceral expression of a war lived in peace on the other side of the world.

‘The shifties are out’. The rumour ripples quickly across the room. Yet another dispute between management and the shift crew has boiled over. ‘Lucky you’, says my work partner for the day, as we file back downstairs to the workshop. ‘You’ll be good for a loan’. Dirk, our supervisor pulls the third and fourth year apprentices together: ‘I need three of you up there each shift. The other blokes are out, union’s put a black-ban on them. You’ll get extra dinner vouchers, but we need you to do as much as you can. Don’t know how long this one’s going to last. Hands up for this afternoon? The rest’ll go home at four and be back at eleven for night shift.’ I immediately feel my apprehension rising. During these disputes the plant runs with only apprentices and staff supervisors responding to breakdowns. Some of the production operators already treat me with disdain, or at the very least, suspicion. The thought of something going wrong on night shift and being unable to fix it fills me with dread.

Repair work: negotiating authority and autonomy

These are the memories that occupy me on the way to my first interview with Bert, an instrument fitter who started his apprenticeship in 1973. We begin by recounting the sections Bert circulated through during his apprenticeship and his early career as a shift electrician, talking about the work cultures shaped by the hot and difficult conditions of the core steelmaking sections, where

pig iron from the blast furnace is mixed with scrap steel and superheated by oxygen. The majestic controlled inferno is still vivid in my mind, as are the tempestuous shift crews who labour in the highly pressured and uncomfortable conditions. Bert reveals the ways shift repair workers operate within multiple bounds of social, material and economic agency, as he talks about his time at the slab mill:

The people down there were great, but I don't miss the work. It was very high-pressure work down there. And people don't seem to realise that it's a continuous process, and if one limit switch fails, it stops. The whole mill stops and...that's what they say it costs up to... well then... fifteen hundred dollars a minute, depending on what they're rolling, so the pressure was on you to get that mill going as quickly as possible.

The work of the shift crews is to respond to breakdown. Small teams – just one or two electricians and a mechanical fitter - work independently of the larger maintenance crews, out of a workshop co-located with the production control room. Being a 'shiftie' has historically been conceived of as a baptism of fire for trades workers at Port Kembla. Participants had all worked in a shift role for a period directly after finishing their apprenticeship, viewing the time as foundational to their ability to respond across multiple scales and between technologies. Contingent conditions created by the volatile processes bestow these workers with the capacity (and arguably the mandate) to restore order using 'whatever works' - an approach that sometimes requires that they circumvent established procedure. The 'employer' (a more ambiguously distributed role in the large enterprise than accounts of collective industrial politics often portray) does not directly oversee production, and production operators historically don't have the skills

to respond when things go wrongⁱ. Continuous production is thus dependent on repair workers autonomously deploying their knowledge and skill – a subtle, yet important form of agency intimately bound up with the bodies of particular workers. They become accomplished at solving problems through daily work that hones in on the flaws in the process, and dismissive of directives from ‘above’, which are often perceived to be impractical, unsafe or unnecessarily onerous. Paradoxically then, the autonomy with which repair workers are required to operate is both necessary and valorised at the same time as it fosters a degree of dissent toward authority, particularly where it is issued from a place outside the bounds of everyday, on-tools experience.

Repair is a key conduit through which skills from the paid workplace spill out into the home and community, carried by this culture of autonomy. Repair and maintenance in the home is first discussed in the context of what tasks participants are able to do for themselves. Skill mobility manifests as particular skills that transfer straightforwardly between the paid workplace and the home, but also where skills are mobilised across the bounds of different trades, through a common disposition for ‘giving it a go’. My account of the trades training centre points to how this is embedded through formal training in a wide range of skills. During our first interview, participant Charlie and I discuss the challenges of first learning to weld, and the way the electrode inevitably bonds to the metal being welded under the heavy, unskilled hand of a beginner. Charlie has been an electrician for more than 30 years, and he attributes his fluid skill-set both to the apprentice training program, and his early career on the shift crews, where rapid responses were critical and reputation built on ‘just get[ting] on with it’. Later we also discuss how strong demarcations between trades and tasks within the steelworks have been slowly

eroded over time by redundancies and downsizing, such that even within the larger maintenance crews workers came to do a wide range of work tasks outside of the trade in which they trained.

Those working as electricians are particularly well placed to undertake a wide range of domestic work, not least because their specialist skills translate directly to the domestic context.

Commercial wiring skills have underpinned the electrical training program at Port Kembla, providing the foundation on which more complex industrial skills are built. All of the electricians interviewed had done work ‘on the side’ at some point in their career, in order to supplement their income, or for friends and family, often in exchange arrangements. Other trades such as fitting and turning involve skills that are less directly transferable to the home itself, but are often applied to other personal domains such as vehicle maintenance. The logic of attempting a task or trade outside of the participant’s expertise is prevalent across all interviews. As Peter walks me through his house he points out a wall that he has moved to make room for a laundry, and the floating timber flooring he has laid, with a dismissive refrain: ‘...yeah, thought I’d give it a go. Thought it can’t be too hard’.

Specialist tools and machinery are central to home-based capacity for repair and maintenance, and most participants own a range of metal and woodworking benches and machinery, as well as welding equipment. Challenges emerge where particular industrial tasks are less suited to the material conditions of the home. Arc welding for example, requires that workers pay close attention to the more flammable domestic materials of timber and plastic, as well as to other members of the household who may not be familiar with safety precautions such as not looking directly at the electrode. Nevertheless, the home and community offer an opportunity for

experimenting with trades, techniques and materials outside of the traditional demarcation of tasks in the paid workplace, or concerns about occupational health and safety. I'm not surprised at a follow-up visit to find Charlie rummaging through his 'plumbing toolbox'. He explains that 'electricity and water both flow the same way – they don't go uphill, they'll always go down to earth, so it's pretty basic'.

Central to expressions of autonomy around the home is the constant work of collecting. Steelworkers are highly attuned to the material abundance that surrounds them, and their collecting practices have historically crossed the boundaries of the workplace and the home in a range of tolerated (and occasionally officially condoned) practices of workplace thrift, known colloquially as 'foreign orders' (Anteby 2008; Adams Stein 2015). My interest is piqued one Saturday morning by a notice in the local paper, advertising a garage sale of old tools and machinery, described as 'ex-steelworks'. And so it happens that I serendipitously re-acquaint myself with Phil, an eccentric trades instructor who had taught me – and several other participants - panel wiring in the training centre. Following the handwritten signs around to the back of his house, I enter a space carved out between brick pier foundations. It is a well-fitted industrial workshop. The benches are covered with hundreds of hand tools marked with prices for sale, and Phil tells me he is moving into a retirement home. In one corner there is a pile of old oscilloscopes, instruments used to analyse electrical circuits. There are bigger items too – a drill press and a metal lathe. Phil explains that the drill press had cost fifty cents and the lathe was fifteen dollars. He purchased them in one of the many legitimate sales of surplus equipment that the steelworks periodically offered to employees during more lucrative times. As machinery was upgraded, workers regularly purchased surplus items for use at home at heavily discounted

prices. All participants own such items – industrial drill presses and heavy-duty bench grinders occupy most workspaces. Arc welders and even metal lathes are relatively commonplace, and speak to the complexity of repair and fabrication tasks that workers are able to undertake in home workspaces. As I leave Phil's house, I encounter a fully operational three tonne hoist mounted on a concrete plinth in the back garden. He tells me that there was an accident at work and the hoist was hit by a vehicle. Rendered unusable, he offered to 'take it off their hands'. He refurbished it, and has used it for the twenty years since, to lift heavy items from vehicles into his steep yard.

For many participants, the drive to fix things at home is connected with an ethic of repair-ability that is deeply entwined with the skilled labouring identities that defined their role in the paid workplace. A focus on these identities in the context of the home revealed how material skills become co-constituted with personal politics and ethics, in many cases centred on care for things and others, or notions of material vulnerability and fragility (Denis and Pontille 2015; Puig de la Bellacasa 2011). Several participants are particularly motivated by the challenge of resurrecting items they have been told are beyond their useful life. This is demonstrated one evening about six weeks after my first meeting with Charlie, when he emails me a photo of a part he has pulled out of an almost-new, premium-branded dishwasher. It's the housing for the control unit, and in the corner I discern a small pop rivet in the plastic frame. Charlie explains in the email that he'd taken it to the supplier, who had sought to charge him 400 dollars for replacing the whole control unit, even though it was functional and only the bracket was broken. He expresses pride – and disbelief – at both the simplicity of the solution, and the inability of the company to adapt its servicing model to replace only what was necessary.

An affinity for repair at home is often tested by the growing prevalence of closed assembly design that dominates household consumer items (Anusas and Ingold 2013). Many participants find the pervasiveness of plastics in the home challenging. Plastics are less common in an industrial environment where equipment is necessarily robust to cope with hot and volatile processes. Bert is particularly incensed by domestic appliances, where pricing models are centred on replacement over repair: 'It's, you know, as people say, we're in a throwaway society... And some of the manufacturers are at fault too, because they'll sell you something cheap, but you buy parts for it...good luck.' These are issues workers encounter much less often in the workplace, where machinery and control equipment must be easily disassembled for fast replacement, because larger repair or replacement tasks are more likely to stop production rolling. For Bert, who has frequently participated in procurement processes for process control equipment, modular repair and replacement is one of the most critical factors he looks for, when assessing suppliers looking to secure a lucrative steelmaking contract. He now applies a similar principle when selecting appliances for home use.

Alternative supply systems for water and electricity proved a fertile application for experimenting with a different kind of autonomy in the home. Out of 18 households, 14 participants had installed solar panels, and all owned a tank for capturing rainwater. Environmental concerns were rarely cited as reasons for installing these items, but rather discussions centred on having control over the resource. Several participants had made modifications to these proprietary systems after they were installed – examples include rewiring or rerouting supply mechanisms to the house, or installing additional pump and irrigation

systems in order to improve their performance beyond what regulatory authorities would allow, or what they had been led to expect. Participant Jack told the story of the recent installation of a new heat pump hot water system in his home, where further probing of what he had been told by the installers led to his rewiring of the system after the installers had left, confirming doubts he already held about the skill of commercial trades:

I said, 'I'll wire it up' and they said, 'no you don't, we'll do that'. I said, 'well are you going to wire it up to off-peak?' and they said, 'you can't do that, you've got to have it on domestic tariff'... So I let them wire it up and when they went I rang up the bloody mob that made it, and I said, 'look I've had one of these [heat pumps] put in... I was wondering if I could put it on the off-peak. I don't see any reason why I couldn't' and they said, 'no, no, you can put it on if you like'. And I thought these other bastards don't know what they're talking about to start with. So I wired up to off peak and mate fair dinkum, in the three months bill, it cost me something like \$28. That's nothing!

Trade skills are not just put to use in participants' own homes, but also widely across the community. All participants discuss the wide range of 'PJs' (Private Jobs) they have undertaken for friends and family. For many, these personal networks stretched to include extended family, friends-of-friends and neighbours, as well as swapping skills with colleagues from other trades. Jack, for example, is committed to using his skills to help the elderly in the community, who he viewed as particularly vulnerable to unscrupulous commercial operators:

Jack: I do a lot of work for older people... I hate seeing older people get ripped off...By people who don't know what they're bloody doing half the time, you know?

Interviewer: Yeah, so electrical work, or just anything?

Jack: Anything! Anything I could fix, you know? I'm pretty lucky, I built my own cars and that sort of thing, mechanically, and um, I can do electrical work obviously...

'Private jobs' regularly intersect with other voluntary work and recreational activities that workers participate in, such as community or sporting groups. There is a conspicuous regional culture of deploying valuable trade skills to assist such groups, particularly where workers are directly involved as members. The work points to established cultures and economies of skill-sharing and generosity that have underpinned the industrial city over a long period of time, where workers use skills gained through their enrolment in capitalist social relations to participate in these other economies. Four participants for example had recently rewired a mess hall at the local scout camp. While the materials were purchased (through participants, at cost) by the organisation, labour was donated in kind by the participants. Bert and Charlie, who were involved in the project, estimated that the group had saved the scouting organisation tens of thousands of dollars.

Later, the scale of assistance shifts up a notch again, when Bert tells me about his long-term volunteer work at the rail heritage centre. Each weekend, he works on a wide range of locomotive repair and maintenance projects. He tells the story of how he managed to secure an entire diesel engine that was marked as scrap, from his employer. A colleague at the diesel

workshop (knowing Bert was a train enthusiast) called him to ask about twelve engines that had been delivered to the scrapyards for cutting up:

...so we just went through them and picked out the best one there, which hadn't been long out of an overhaul, we grabbed the turbo off one of 'em... and other bits and pieces, and we put a letter in to the steelworks, 'can we we buy one for scrap?' and we had a truck ...behind the diesel shop, and... we sent it up to Thirlmere, so it had gone up there, and then we got a letter from the steelworks and they just said, 'you can have it for \$600' and we said 'it's gone already!'

Interviewer: So you didn't end up paying for it?

Bert: Yeah, yeah we paid for it. But you've got to keep your eye out for bits and pieces that are around...

As I spent time talking with Bert about his volunteer work, it became clear that he spends the vast majority of his leisure time engaged in activities that look remarkably similar to those he undertook in his paid role. This entwining of skilled work in both paid and volunteer modes troubles common (and arguably middle-class) assumptions about manual work as a constraining factor on the more pleasurable condition of leisure.

Maintenance work: schedules, routines and material order

Maintenance work at Port Kembla operates in entirely different temporal, social and spatial registers to that of repair work. Maintenance crews have historically been largeⁱⁱ, drawing the greater proportion of apprentices as they finish their training, as well as repair crew workers

looking for permanent day work, often at a time when shift work becomes incompatible with family life. All participants had spent the majority of their working careers performing, planning and supervising maintenance labour. It is in many ways more stable work than that of the repair crews, with particular tasks set for different time cycles, ranging from daily to annual schedules, as well as less frequent major overhauls and upgrades. The cyclical nature of maintenance produces a different set of social relations to that of repair work, that become embedded through the constant interaction engendered by the social spaces of the workshop, the storeroom, the changeroom and the lunchroom, as well as the nature of physical work itself. Or as participant Peter more simply points out, ‘We talked a lot! When you’re doing stuff with your hands you don’t need to stop talking... ever’.

But while repetition and routine engenders predictable days, it does not necessarily produce mundane work. Maintenance processes draw on the deep embodied experience of workers to anticipate how materials will thwart, breakdown and decay (DeSilvey 2007; Edensor 2011; Ingold 2013). As Bert describes different mill re-fits and upgrade processes that have occurred during his forty-year career, I am struck by his intimate knowledge of how systems have been layered over this time. I have to reach deep into my memory for acronyms and a technical language I’ve long left behind, when he speaks in vivid detail about connecting new systems with old, and the complex entanglement of electrical and mechanical systems. To work within recurring rhythms of planned maintenance hones the ability to discern minute changes to processes and outputs, to recognise when things are starting to fail, and to take action to prevent further degradation in a timely way (Graham and Thrift 2007). Maintenance workers come to know the plant on which they work intimately, and often work across traditional trade

demarcations, to get things done efficiently. As participants each tell a story of how the cultures of the steelworks and the work they did changed over time, they reveal the constant micro-processes of experimentation and adaptation – the endless trialling and tweaking - that characterise work in a context where interruption is profoundly shunned.

Like repair, these cultures of maintenance are enfolded into identities that accompany workers beyond the workplace (Lovelock 1999). The drive to constantly return to something until it is perfected is demonstrated across all homes, where projects are revisited continuously over months and years, with minor adjustments. Maintenance techniques from the workplace are used to manage regular maintenance in the home, though the means of keeping schedules are somewhat less formal – fridge lists, whiteboards and calendar notes, rather than complex enterprise software. Charlie laughs when I draw attention to the efficient whiteboard in his garage, on which a hand-drawn calendar details home tasks for the month – cleaning gutters, replacing the filters and gaskets on the water tank and the fridge and testing the fire alarm batteries. There is another list of tasks connected with his passion for food production, including vegetable planting and fertilising schedules, and medication schedules for his laying hens. And then a third list, detailing a list of repairs for other occupants of the medium-density housing complex he lives in. After being elected as the owners' representative on the body corporate board, Charlie found that his skills as an electrician meant it was often easier to undertake the work himself, rather than deal with 'bloody phone calls all day long, to this person and that person, and no one's got any idea what you're talking about. They're all just paper-pushers! It's quicker, honestly... it really is, to just get in and do the job yourself'.

Finally, for many participants, maintenance in the home manifests in an ethic of material longevity and durability, that is often at odds with the built fabric of suburban dwelling. The tool collections and machinery on display are for the most part carefully organised, unusually clean and very well maintained. During my house tour with Jack, we spend most of the time examining items that he has fashioned from stainless steel, including a barbeque and a wood-burning stove that closely resemble commercial models, yet have been built by Jack using material ‘thrifty’ from the workplace. He talks about a long-term project of upgrading various household items and materials to stainless steel, to minimise ongoing maintenance. We examine garden tools that he is able to leave in the garden without fear of rust, and the guttering on his home, which has been fully replaced for the same reason. The guttering he explains, would become difficult to access as he ages, and so he was motivated to upgrade it while he was still physically able, minimising the need for costly and arduous maintenance in the future.

For Charlie meanwhile, maintenance is a way of disconnecting from conspicuous consumption, where looking after everyday items works against the ‘powerful tide of induced obsolescence...’ (DeSilvey and Ryan 2013), that he experiences much more tangibly in the home than at work. As we move between the garage and shed, he shows me garden tools where broken timber handles have long been replaced with steel rods (‘not going anyway, those’), the hub of an old steel wheelbarrow where splatters of flux divulge a fast fix, and a hammer, its broken claw re-welded ‘oh, close to twenty years ago now I’d guess’. As we move from a custom washing machine bracket to a box of ‘dead’ power tools kept for spare parts, we talk about how maintenance workers are shaped by routines of anticipation, developing and honing tacit skills that remain largely overlooked in accounts of industrial labour. Charlie is adamant that

maintenance saves both money and time in the long term – whether at home with everyday consumer items, or at the steelworks, under the spectre of a volatile production process.

Conclusion

“I’ve got something for you, before you go”. My parents are moving house, and I follow my father into a garage filled with boxes. He gestures to the bench, where I immediately recognise the soldering iron and the battery charger I made in my first months at Port Kembla. The soldering iron is looking slightly worse for wear, the barrel is rusted and its electric cord severed – I vaguely remember a prank towards the end of that first year. I wipe the dust from the gauges on the front of the battery charger, and ask if it still works. My father tells me he had to re-solder a connection a few years ago, but other than that, it’s ‘just like a bought one’.

These items sit on my desk today, totemic companions on a journey that started out in the direction of the industrial complex. My eyes had been fixed on the devalued and largely invisible skills and dispositions that I knew to reside there. But the workers I was looking for were not always to be found where I had left them all those years ago, nor doing the work they had always done. In September 2001, the company reached agreements with unions to outsource the maintenance and repair functions at Port Kembla. It was expected that the move would save them \$150 million over 10 years. Some things remained the same: many workers finished up working for the company on a Friday, and re-commenced with a contracting company the following Monday doing exactly the same work under more precarious conditions (Warren, forthcoming). Over the following 10 years Port Kembla’s fluctuating fortunes continued, causing

some to walk away from maintenance and repair (often the only work they had ever known) entirely. In August 2011 the crisis narrative reached a new level, driven by competitive pressures and a weakening world demand for steel. The company announced radical measures: exports would cease immediately, a blast furnace would be mothballed, and some 1000 workers - 20 percent of what remained of the workforce - would be retrenched, in a last-ditch bid to stave off closure.

All of the participants interviewed for this project had extensive first-hand experience of these cycles of abundance and redundancy that have come to characterise steelmaking throughout the 20th century and beyond. One direction the project could have taken in its focus on the everyday, lived experiences of industrial work would be to document the effects of these rolling changes on workers and their families. But by bringing a less-familiar lens to bear on industrial labour, different insights have emerged. Feminist perspectives that open up the discourse on where work occurs and how it is valued have offered an opportunity to re-cast industrial repair and maintenance as meaningful social and economic work, that remains largely undervalued. That this work slips between the formal workplace and other spaces in the home and community illustrates the manifold ways and places in which individuals become working subjects. Its slipperiness only serves to highlight the limitations of spatial and temporal categorical binaries that locate social reproduction, leisure and consumption in the home and production and work in the 'workplace' (Meehan and Strauss 2015).

Unlike many of its ilk in wealthy economies across the world, the Port Kembla steelworks still hums with life today, though the changes outlined above have had a profound effect on the

timbre of the city. Political attention continues to wax and wane around job losses and regional unemployment, and more broadly the future of manufacturing both regionally and nationally (Gibson et al 2012). But alongside these big-ticket discussions, more subtle shifts in the culture of the industrial city have been overlooked. The apprentice-training centre has closed, and technical colleges largely decimated, in favour of a higher education sector more focused on the 'new economy'. Historically, the Port Kembla steelworks has dominated local employment since the early 20th century, but now the university is the region's largest employer. For the participants interviewed for this project, this shift has not gone unnoticed. The soldering iron is as much a tool at my disposal today as it was all those years ago, becoming a tangible prompt for valuable conversations about the nature of apprenticeship. Participants are interested in my experiences of the full gamut of higher education, but are frank in their doubt that it offers the same scope for bringing together the formation of character with the passing on of technical skill (Marchand 2008 Suchman 1987). We spend a great deal of time discussing the alternatives, but find few that offer the same opportunities.

The battery charger meanwhile serves as different kind of tangible reminder, this time of how emancipatory simple execution can be. Functionality. Longevity. Repairability. These are the material qualities the participants I have spent time with care most about. They are also qualities that will become increasingly valuable in the context of what certainly look to be more volatile futures (Carr and Gibson 2016). I continue to question which experience has been more transformative – that of beginning my working life in the steelworks, or returning to look at it through fresh eyes. What I do see more clearly now, is a constellation of projects and experiences that were carefully designed and sequenced to prepare workers for encounters with

contingency and happenstance every day. Knowing how to fix things with ingenuity, or how to extend the life of things through skilled maintenance literally embodies the type of resourcefulness in everyday practice that will undoubtedly be needed in the future (Carr and Gibson 2016; Gibson et al 2015). In a region that will continue to grapple with restructuring and its impacts, re-engaging with such workers and practices offers an opportunity to look beyond the ‘victim’ positionality that continues to dominate policy and media narratives of industrial decline. Functionality. Longevity. Repairability. One wonders what would the world look like if we placed these qualities at the centre of our industrial systems - perhaps ironically where they have always been.

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ⁱ This changed in the early 2000s, where management, in a bid to cut costs further, pursued a strategy of employing maintenance trades workers as production operators, with the intention that they would be able to both oversee the process, and attend to breakdown where necessary. This conflation of roles was a source of significant antagonism for the company and its workers.

ⁱⁱ The BOS maintenance workshop housed around 100 workers during my time there in the 1990s. The outsourcing and subsequent major restructuring of the entire maintenance function has significantly changed how maintenance is undertaken today.